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(54) AN INTERNAL COMBUSTION ENGINE

BRENNKRAFTMASCHINE

MOTEUR A COMBUSTION INTERNE

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Description

The present invention relates to internal combustion engines and to the problem of noise reduction in such engines.

It is known, for example from GB 2 234 011 to provide an internal combustion engine comprising a cylinder block, an upper crankcase, a lower crankcase, a crankshaft and a sump attached to a skirt on the cylinder block and defining a sump region, wherein the lower crankcase comprises an inner casing attached to the upper crankcase such that the upper crankcase and the inner casing support the crankshaft.

This design suffers from the disadvantages that noise is transmitted from the inner casing to the sump and transferred from the upper crankcase to the sump.

In DE-C-4204522 it is known to provide an upper crankcase and a lower crankcase, the lower crankcase providing a sump. Although inner and outer casings are provided, they both form part of a common member mounted on the upper crankcase.

Accordingly the present invention provides an internal combustion engine comprising a cylinder block, an upper crankcase, a lower crankcase, a crankshaft and a sump defining a sump region, wherein the lower crankcase comprises an inner casing attached to the upper crankcase such that the upper crankcase and the inner casing support the crankshaft, characterised in that the lower crankcase further comprises an outer casing attached to the upper crankcase and having at least a portion thereof spaced from the inner casing thereby to reduce the transmission of noise from the inner casing to the outer casing, and both casings extend beneath the crankshaft thereby to separate it from the sump region. This arrangement can help to reduce the noise transmitted from the inner crankcase to the sump.

Preferably the inner casing comprises a plurality of bearing support portions joined by casing portions.

More preferably the inner casing is formed as a single casting.

Preferably the outer casing comprises a separate member attached to the upper crankcase by fixings. This can help to isolate the sump from vibration in the upper crankcase, particularly if the sump is attached to the outer casing.

Preferably the upper crankcase has oil drainage passages arranged to drain oil into the space between the inner and outer casings. This oil helps to dampen noise and is kept away from the crankshaft by the inner casing which reduces drag.

Desirably the inner casing has openings therein to allow oil to drain from inside the inner casing to the space between the inner and outer casings.

Preferably, in the region of at least one web of the crankshaft, the upper crankcase and the inner casing define a space which is substantially circular in cross section in which the web rotates. Desirably the diameter of said cross section is only slightly larger than the diameter of the circle swept out by the web as it rotates. This helps to reduce the amount of air circulating with the crankshaft and therefore helps to reduce drag.

The inner casing may meet the upper crankcase approximately level with the axis of the crankshaft.

Preferably the outer casing has two side walls attached to the upper crankcase and a base joining the side walls and extending between the inner casing and the sump region.

Preferably the outer casing further comprises a depending skirt to which the sump is attached.

The outer casing may meet the upper crankcase approximately level with the axis of the crankshaft.

Preferably the upper crankcase has two longitudinal passageways formed therein, one on either side of the axis of the engine, which extend substantially the whole length of the crankcase and serve to stiffen the upper crankcase, the passageways being enclosed within the upper crankcase.

Preferably the passageways are spaced from the lower face of the upper crankcase.

Desirably the passageways each have a lower wall formed in the upper crankcase and separating them from the lower face of the upper crankcase.

Preferably drainage passages defined in the upper crankcase extend from the passageways to the lower face of the upper crankcase.

Preferred embodiments of the present invention will now be described by way of example only with reference to the accompanying drawings in which:-

Figure 1 is a cross section through an engine according to the invention;

Figure 2 is a cross section through the engine of Figure 1 at a different point, and on a larger scale;

Figure 3 is a longitudinal section through the engine of Figure 1; and

Figures 4 and 5 are side views from opposite sides of the cylinder block and upper crankcase of the engine of Figure 1.

Referring to Figure 1 an engine according to an embodiment of the invention is in a V6 configuration and comprises a cylinder block 10 having two rows of three cylinders 12, an upper crankcase 14 formed with the cylinder block 10 as a single casting 16, two cylinder heads 18,20, a lower crankcase 22, and a crankshaft 24.

As can be seen from Figures 2, 4 and 5, oil drainage passages 32 extend through the cylinder block 10 from the cylinder head faces 28, downwards to the lower faces 33 of the upper crankcase 14. At their upper ends the drainage passages 32 surround the outer cylinder head bolts (not shown) which hold the cylinder heads 18,20 to the cylinder block 10. They then deviate away from the lower ends of the cylinder head bolts before reaching

the lower faces 33 of the upper crankcase 14. A pair of longitudinal passages 34,36 run along the upper crankcase 14 parallel to the crankshaft 24 near the crankcase split line 38, one on either side of the crankshaft 24. As can best be seen in Figure 1, the passages 34, 36 are defined entirely by the upper crankcase and are enclosed within it. They have a lower wall 37 which separates them from the lower crankcase 44. They each connect together the drainage passages 32 on one side of the crankcase just above the crankcase split line 38. Because they extend along substantially the full length of the upper crankcase 14 they add considerably to its stiffness. The lower ends of the drainage passages 32 form drainage ports 40 which lead from the longitudinal passages 34,36 down to the crankcase split line 38.

Breathing passages 26 also extend through the cylinder block 10 from the cylinder head faces 28, where they surround the inner cylinder head bolts (not shown), down into the region of the crankcase 14 above the crankshaft 24. The lower ends of these breathing passages are baffled to prevent oil being thrown back up into them.

As can best be seen in Figures 2 and 3, the lower crankcase 22 comprises an inner casing 42 and an outer casing 44. The inner casing 42 is a single casting comprising the lower four main bearing housings 46 forming the bearing ladder with casing portions 58 joining them together and forming an outer wall 41. The inner casing 42 secured at its upper edge 47 to the upper crankcase by bolts (not shown), two on either side of each main bearing housing 46. The crankshaft 24 is of conventional design having webs 48 to balance the crankpins 50. The outer wall 41 of the inner casing 42 has a pair of inward projections 52 arranged to be just clear of the outer edge of each of the webs 48 as they rotate. These projections skim oil off the webs as they rotate thereby reducing the amount of oil which is flung off the webs. A set of openings 54 in the inner casing 42 are provided next to the projections 52 to allow oil to drain out into the space 56 between the inner and outer casings. One side of each projection 52 forms a single surface 53 with one side of a respective one of the openings 54 so that oil skimmed off by the projections runs directly down through the openings.

The cross section of the interior of the crankcase in the regions 58 between the main bearings 46 is substantially circular and is only slightly larger in radius than the crankshaft webs 48. This results in very low air drag acting on the crankshaft as it rotates.

The outer casing 44 is a single casting surrounding the inner casing and is attached at its upper edge 59 to the upper crankcase 14 by a series of bolts (not shown) along its upper face 60. It has two side walls 62 and a base 64 which are spaced from the inner casing 42. At one end it has an end wall 66 which is also spaced from the inner casing 42 and forms part of the flywheel housings 67. The inner casing 42 is therefore separated from the flywheel housing 67 by the end wall 66 of the outer casing 44. At the other end 68 it forms a lower mounting face 70 for the oil pump 72 which is also attached to a main mounting face 74 formed by the upper crankcase 16 and the inner casing 42. Depending from the side walls 62 is an outer skirt 76 with an oil sump mounting face 78 on its lower edge. A series of openings 80 in the outer casing allow oil to drain out into the sump 81.

The upper edges 47,59 of the inner and outer casings 42,44 are spaced apart where they meet the upper crankcase 16 at the crankcase split line 38, which is approximately level with the axis of the crankshaft.

The oil drainage ports 40 from the longitudinal passages 34,36 in the upper crankcase 14 open into the space 56 between the inner and outer casings 42,44. Oil from the longitudinal passages 34,36 therefore flows down in the space between the inner and outer casings 42,44.

As the crankshaft is held between the upper crankcase 14 and the inner casing 42, the vibrations it causes are largely isolated from the outer casing 44 of the lower crankcase. Thus the amount of vibration transmitted to the outer walls of the lower crankcase is reduced, thereby reducing the amount of noise produced there. Also because the inner casing 42 and the base 64 of the outer casing 44 both extend beneath the crankshaft 24 they form a double barrier between the crankshaft and the sump 81 which reduces the amount of noise radiated into the sump, thereby reducing the amount of vibration of sump and noise produced there. This reduction in noise is also helped by the oil between the inner and outer casings of the lower crankcase which tends to damp out noise transmitted between them.

Although this invention has been described with particular reference to a V6 engine, it will be appreciated that it can also be used in other engine designs, such as in line engines.

Claims

1. An internal combustion engine comprising a cylinder block (10), an upper crankcase (14), a lower crankcase (22), a crankshaft (24) and a sump (81) defining a sump region, wherein the lower crankcase (22) comprises an inner casing (42) attached to the upper crankcase (14) such that the upper crankcase (14) and the inner casing (42) support the crankshaft (24), characterised in that the lower crankcase (22) further comprises an outer casing (44) attached to the upper crankcase (14) and having at least a portion thereof spaced from the inner casing (42) thereby to reduce the transmission of noise from the inner casing (42) to the outer casing (44), and both casings extend beneath the crankshaft (24) thereby to separate it from the sump region.

2. An engine according to claim 1 wherein the inner

casing comprises a plurality of bearing support portions (46) joined by casing portions (58).

3. An engine according to claim 2 wherein the inner casing (42) is formed as a single casting.

4. An engine according to any foregoing claim wherein the outer casing (44) comprises a separate member attached to the upper crankcase (14) by fixings.

5. An engine according to any foregoing claim wherein the sump (81) is attached to the outer casing (44).

6. An engine according to any foregoing claim wherein the upper crankcase (14) has oil drainage passages (32) arranged to drain oil into the space (56) between the inner and outer casings (42,44).

7. An engine according to any foregoing claim wherein the inner casing (42) has openings (54) therein to allow oil to drain from inside the inner casing to the space (56) between the inner and outer casings (42,44).

8. An engine according to any foregoing claim wherein, in the region of at least one web (48) of the crankshaft (24), the upper crankcase (14) and the inner casing (42) define a space (58) which is substantially circular in cross section in which the web (48) rotates.

9. An engine according to claim 8 wherein the diameter of said cross section (58) is only slightly large than the diameter of the circle swept out by the web (48) as it rotates.

10. An engine according to any foregoing claim wherein the inner casing (42) meets the upper crankcase (14) approximately level with the axis of the crankshaft (24).

11. An engine according to any foregoing claim wherein the outer casing (44) has two side walls (62) attached to the upper crankcase (14) and a base (64) joining the side walls (62) and extending between the inner casing (42) and the sump region.

12. An engine according to claim 10 wherein the outer casing (44) further comprises a depending skirt (76) to which the sump (81) is attached.

13. An engine according to any foregoing claim wherein the outer casing (44) meets the upper crankcase (14) approximately level with the axis of the crankshaft (24).

14. An engine according to any foregoing claim wherein the upper crankcase (14) has two longitudinal passageways (34,36) formed therein, one on either side of the axis of the engine, which extend substantially the whole length of the crankcase (14) and serve to stiffen the upper crankcase (14), the passageways (34,36) being enclosed within the upper crankcase (14).

15. An engine according to claim 14 wherein the passageways (34,36) are spaced from the lower face of the upper crankcase (14).

16. An engine according to claim 14 or 15 wherein the passageways (34,36) each have a lower wall (37) formed in the upper crankcase (14) and separating them from the lower face of the upper crankcase (14).

17. An engine according to any one of claims 14 to 16 wherein drainage passages (40) defined in the upper crankcase (14) extend from the passageways (34,36) to the lower face of the upper crankcase (14).

Patentansprüche

1. Verbrennungsmotor, der einen Zylinderblock (10), ein oberes Kurbelgehäuse (14), ein unteres Kurbelgehäuse (22), eine Kurbelwelle (24) und einen einen Sumpfbereich bildenden Sumpf (81) aufweist, wobei das untere Kurbelgehäuse (22) ein inneres Gehäuse (42) aufweist, das an dem oberen Kurbelgehäuse (14) derart befestigt ist, daß das obere Kurbelgehäuse (14) und das innere Gehäuse (42) die Kurbelwelle (24) abstützen, **dadurch gekennzeichnet,** daß das untere Kurbelgehäuse (22) ferner ein äußeres Gehäuse (44) aufweist, das an dem oberen Kurbelgehäuse (14) befestigt ist und von dem mindestens ein Teil einen Abstand von dem inneren Gehäuse (42) hat, um dadurch die Übertragung von Geräuschen von dem inneren Gehäuse (42) auf das äußere Gehäuse (44) zu vermindern, und sich beide Gehäuse unter die Kurbelwelle (24) erstrecken, um sie dadurch vom Sumpfbereich zu trennen.

2. Motor nach Anspruch 1, bei welchem das innere Gehäuse eine Vielzahl an Lagerstützteilen (46) aufweist, die durch Gehäuseteile (58) miteinander verbunden werden.

3. Motor nach Anspruch 2, bei welchem das innere Gehäuse (42) ein einzelnes Gußteil ist.

4. Motor nach einem vorhergehenden Anspruch, bei welchem das äußere Gehäuse (44) ein separates Teil aufweist, das an dem oberen Kurbelgehäuse (14) durch Befestigungsmittel befestigt ist.

5. Motor nach einem vorhergehenden Anspruch, bei welchem der Sumpf (81) an dem äußeren Gehäuse (44) befestigt ist.

6. Motor nach einem vorhergehenden Anspruch, bei welchem das obere Kurbelgehäuse (14) Ölablaufkanäle (32) hat, um Öl in den Raum (56) zwischen dem inneren und äußeren Gehäuse (42, 44) abzuleiten.

7. Motor nach einem vorhergehenden Anspruch, bei welchem das innere Gehäuse (42) Öffnungen (54) hat, um Öl von der Innenseite des inneren Gehäuses zu dem Raum (56) zwischen dem äußeren und inneren Gehäuse (42, 44) ablaufen zu lassen.

8. Motor nach einem vorhergehenden Anspruch, bei welchem das obere Kurbelgehäuse (14) und das innere Gehäuse (42) im Bereich mindestens eines Flansches (48) der Kurbelwelle (24) einen Raum (58) begrenzen, der im wesentlichen kreisförmig im Querschnitt ist, in welchem sich der Flansch (48) dreht.

9. Motor nach Anspruch 8, bei welchem der Durchmesser des Querschnitts (58) nur wenig größer als der Durchmesser des Kreises ist, der von dem Flansch (48) überstrichen wird, während er sich dreht.

10. Motor nach einem vorhergehenden Anspruch, bei welchem das innere Gehäuse (42) mit dem oberen Kurbelgehäuse (14) ungefähr auf der Höhe der Achse der Kurbelwelle (24) zusammentrifft.

11. Motor nach einem vorhergehenden Anspruch, bei welchem das äußere Gehäuse (44) zwei Seitenwände (62), die an dem oberen Kurbelgehäuse (44) befestigt sind, und einen Boden (64) hat, der die Seitenwände (62) miteinander verbindet und sich zwischen dem inneren Gehäuse (42) und dem Sumpfbereich erstreckt.

12. Motor nach Anspruch 10, bei welchem das äußere Gehäuse (44) ferner eine herabhängende Schürze (76) aufweist, an welcher der Sumpf (81) befestigt ist.

13. Motor nach einem vorhergehenden Anspruch, bei welchem das äußere Gehäuse (44) mit dem oberen Kurbelgehäuse (14) ungefähr auf der Höhe der Achse der Kurbelwelle (24) zusammentrifft.

14. Motor nach einem vorhergehenden Anspruch, bei welchem das obere Kurbelgehäuse (14) zwei längsgerichtete Durchgänge (34, 36) hat, und zwar au jeder Seite der Achse des Motors einen, die sich im wesentlichen über die ganze Länge des Kurbelgehäuses (14) erscrecken und dazu dienen, das obere Kurbelgehäuse (14) zu versteifen, wobei die Durchgänge (34, 36) in das obere Kurbelgehäuse (14) eingeschlossen sind.

15. Motor nach Anspruch 14, bei welchem die Durchgänge (34, 36) einen Abstand von der unteren Stirnfläche des oberen Kurbelgehäuses (14) haben.

16. Motor nach Anspruch 14 oder 15, bei welchem die Durchgänge (34, 36) jeweils eine untere Wand (37) haben, die in dem oberen Kurbelgehäuse (14) gebildet ist und sie von der unteren Stirnfläche des oberen Kurbelgehäuses (14) trennt.

17. Motor nach einem der Ansprüche 14 bis 16, bei welchem in dem oberen Kurbelgehäuse (14) gebildete Ablaufkanäle (14) sich von den Durchgängen (34, 36) zu der unteren Stirnfläche des oberen Kurbelgehäuses (14) erstrecken.

Revendications

1. Moteur à combustion interne comprenant un bloc de culasse (10), un carter supérieur (14), un carter inférieur (22), un vilebrequin (24) et un puisard (81) définissant une région formant puisard, dans lequel le carter inférieur (22) comprend une gaine intérieure (42) fixée au carter supérieur (14) de sorte que le carter supérieur (14) et la gaine intérieure (42) supportent le vilebrequin (24), caractérisé en ce que le carter inférieur (22) comprend en outre une gaine extérieure (44) fixée au carter supérieur (14) et dont au moins une partie est écartée de la gaine intérieure (42), pour ainsi diminuer la transmission du bruit entre la gaine intérieure (42) et la gaine extérieure (44), et en ce que les deux gaines s'étendent sous le vilebrequin (24), pour ainsi le séparer de la région formant puisard.

2. Moteur selon la revendication 1 dans lequel la gaine intérieure comprend une pluralité de parties de support de palier (46) reliées par des parties de gaine (58).

3. Moteur selon la revendication 2 dans lequel la gaine intérieure (42) est formée d'une seule coulée.

4. Moteur selon l'une quelconque des revendications précédentes dans lequel la gaine extérieure (44) comprend un élément séparé fixé au carter supérieur (14) par des fixations.

5. Moteur selon l'une quelconque des revendications précédentes dans lequel le puisard (81) est fixé à la gaine extérieure (44).

6. Moteur selon l'une quelconque des revendications précédentes dans lequel le carter supérieur (14) comporte des passages d'évacuation d'huile (32) agencés de manière à évacuer l'huile dans l'espace (56) compris entre les gaines intérieure et extérieure (42, 44).

7. Moteur selon l'une quelconque des revendications précédentes dans lequel la gaine intérieure (42) comporte des ouvertures (54) permettant d'évacuer l'huile de l'intérieur de la gaine intérieure et de la faire pénétrer dans l'espace (56) compris entre les gaines intérieure et extérieure (42, 44).

8. Moteur selon l'une quelconque des revendications précédentes dans lequel, dans la région d'au moins un bras (48) du vilebrequin (24), le carter supérieur (14) et la gaine intérieure (42) forment un espace (58) qui a une section transversale de forme sensiblement circulaire et dans lequel le bras (48) tourne.

9. Moteur selon la revendication 8 dans lequel le diamètre de ladite section transversale (58) n'est que légèrement plus grand que le diamètre du cercle balayé par le bras (48) lorsqu'il tourne.

10. Moteur selon l'une quelconque des revendications précédentes dans lequel la gaine intérieure (42) rencontre le carter supérieur (14) approximativement au niveau de l'axe du vilebrequin (24).

11. Moteur selon l'une quelconque des revendications précédentes dans lequel la gaine extérieure (44) comporte deux parois latérales (62) fixées au carter supérieur (14) et un fond (64) reliant les parois latérales (62) et s'étendant entre la gaine intérieure (42) et la région formant puisard.

12. Moteur selon la revendication 10 dans lequel la gaine extérieure (44) comprend en outre une jupe solidaire (76) à laquelle est fixé le puisard (81).

13. Moteur selon l'une quelconque des revendications précédentes dans lequel la gaine extérieure (44) rencontre le carter supérieur (14) approximativement au niveau de l'axe du vilebrequin (24).

14. Moteur selon l'une quelconque des revendications précédentes dans lequel le carter supérieur (14) comporte deux passages longitudinaux (34, 36) formés à l'intérieur de celui-ci, chaque passage étant disposé de chaque côté de l'axe du moteur, qui s'étendent sur sensiblement toute la longueur du carter (10) et servent à augmenter la rigidité du carter supérieur (14), ces passages (34, 36) étant enfermés à l'intérieur du carter supérieur (14).

15. Moteur selon la revendication 14 dans lequel les passages (34, 36) sont écartés de la face inférieure du carter supérieur (14).

16. Moteur selon la revendication 14 ou 15 dans lequel les passages (34) 36) ont chacun une paroi inférieure (37) formée dans le carter supérieur (14) et qui les sépare de la face inférieure du carter supérieur (14).

17. Moteur selon l'une quelconque des revendications 14 à 16 dans lequel les passages d'évacuation (40) formés dans le carter supérieur (14) s'étendent entre les passages (34, 36) et la face inférieure, du carter supérieur (14).

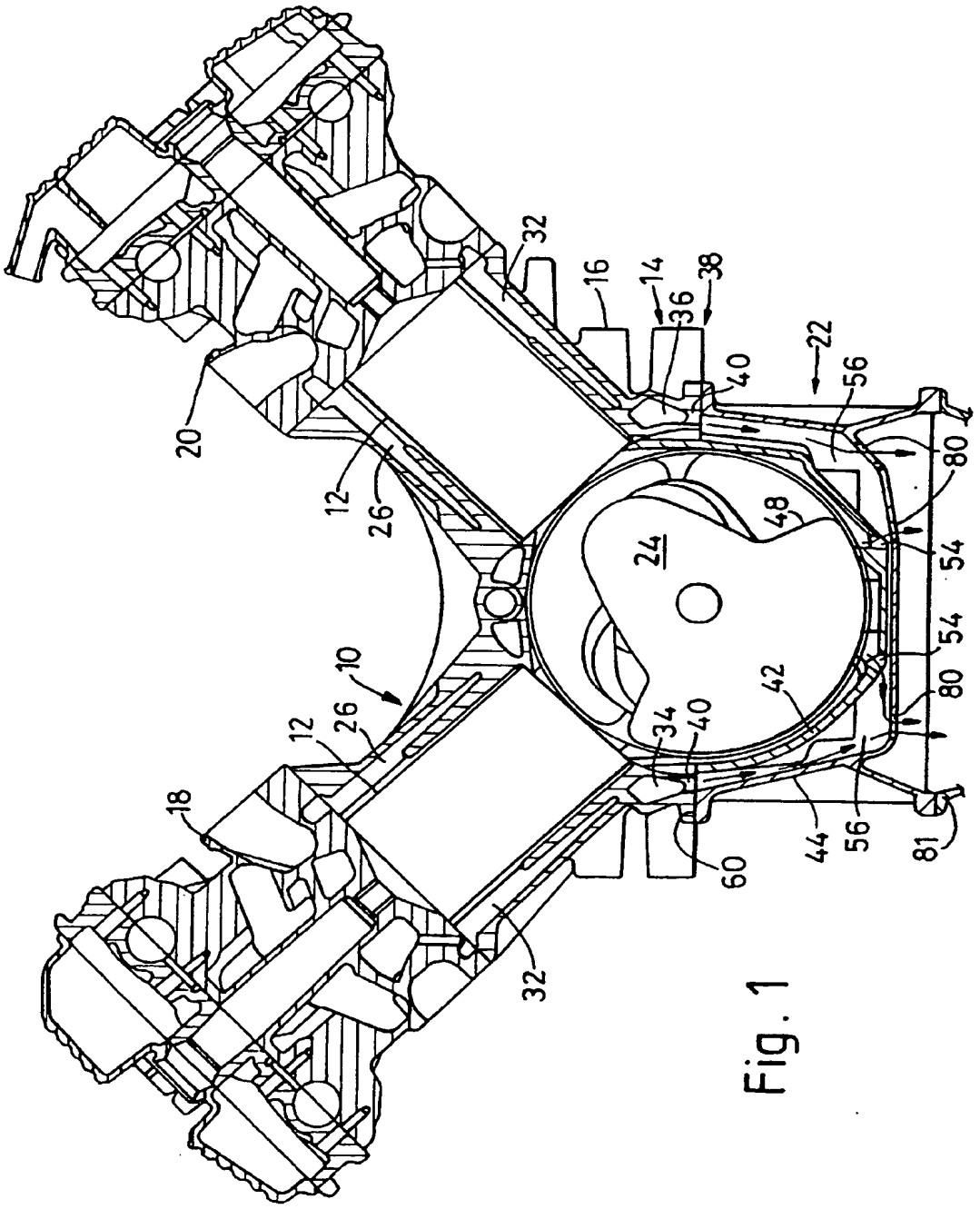

Fig. 1

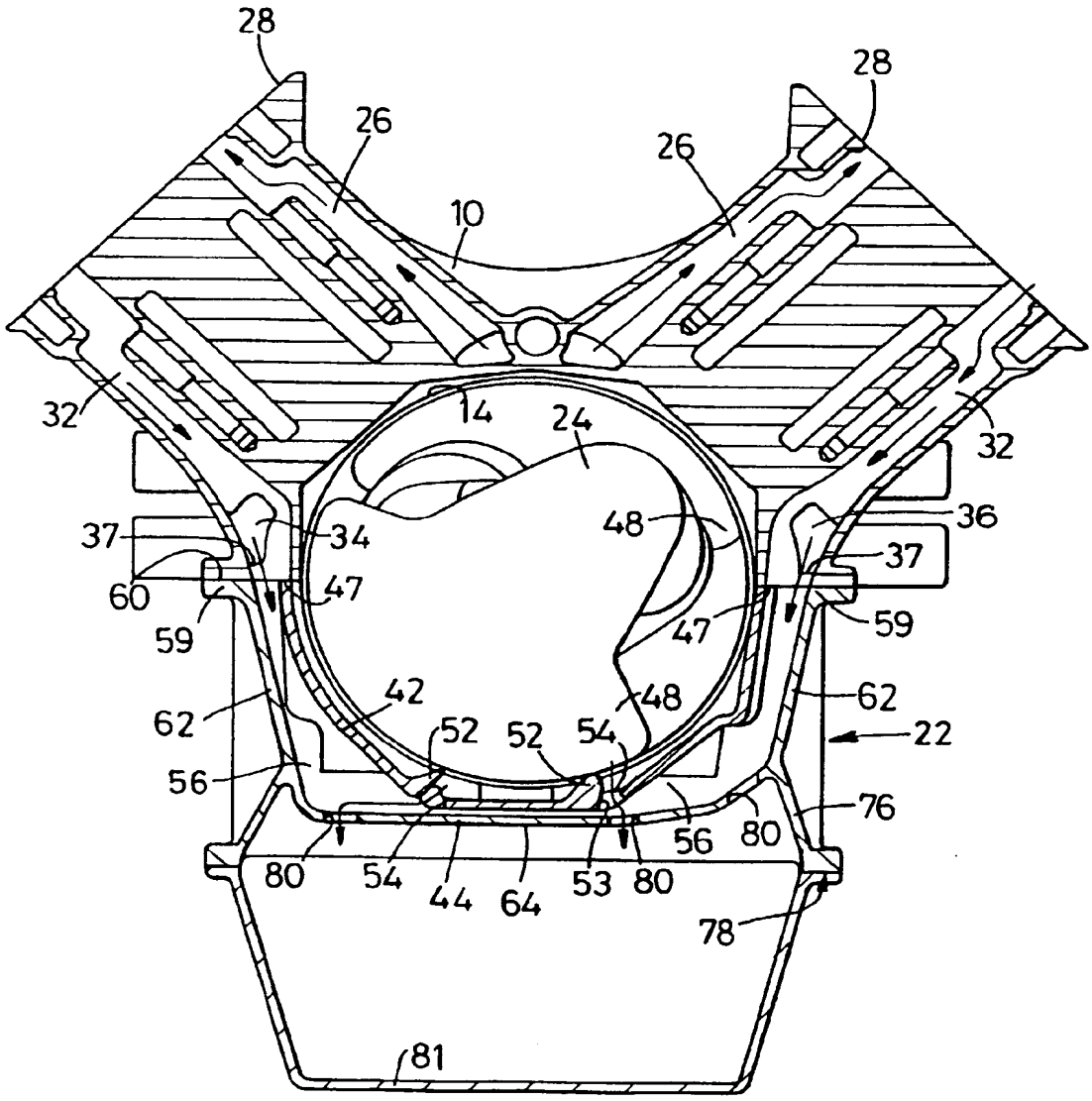
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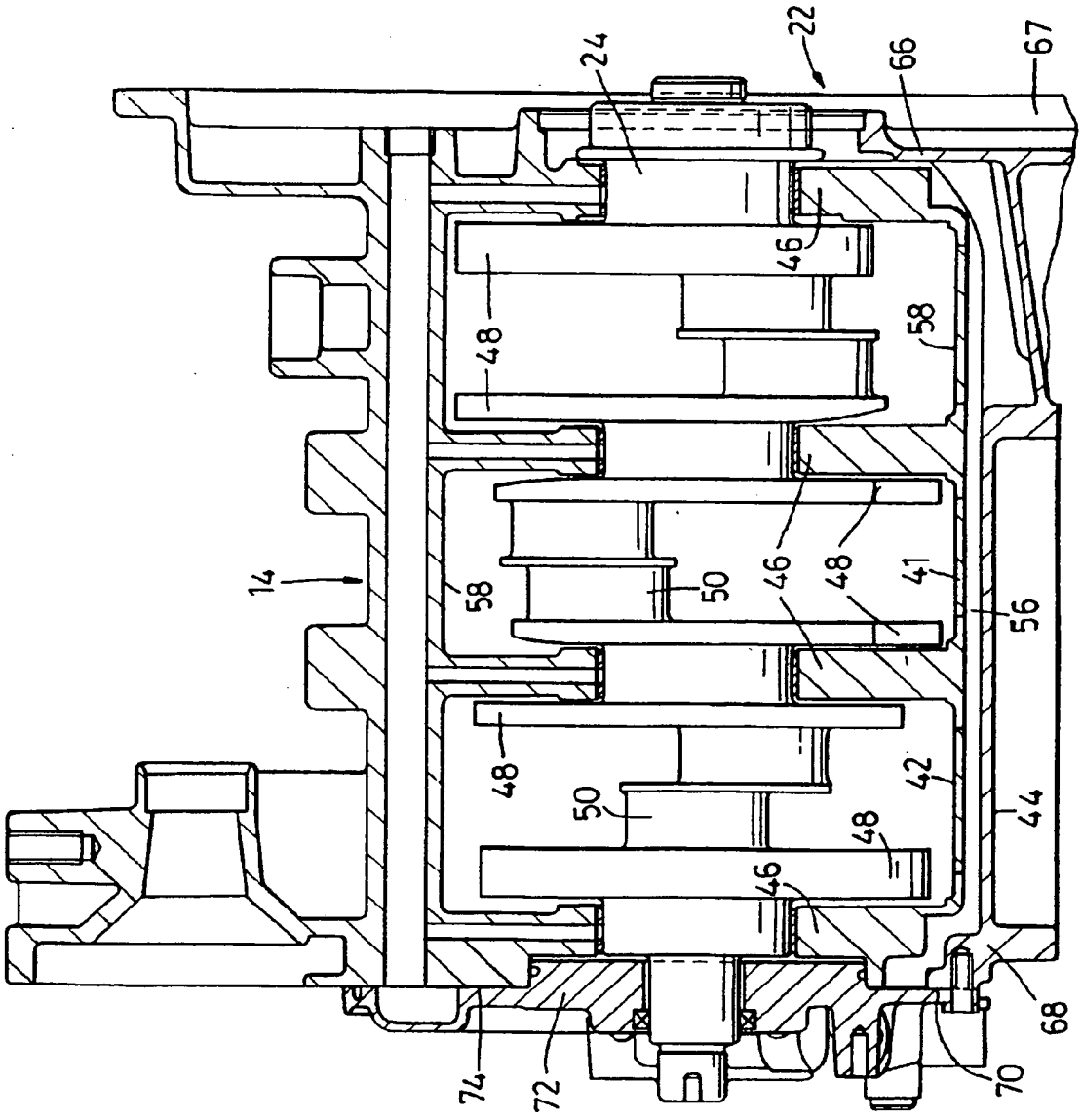
Fig. 2

Fig. 3



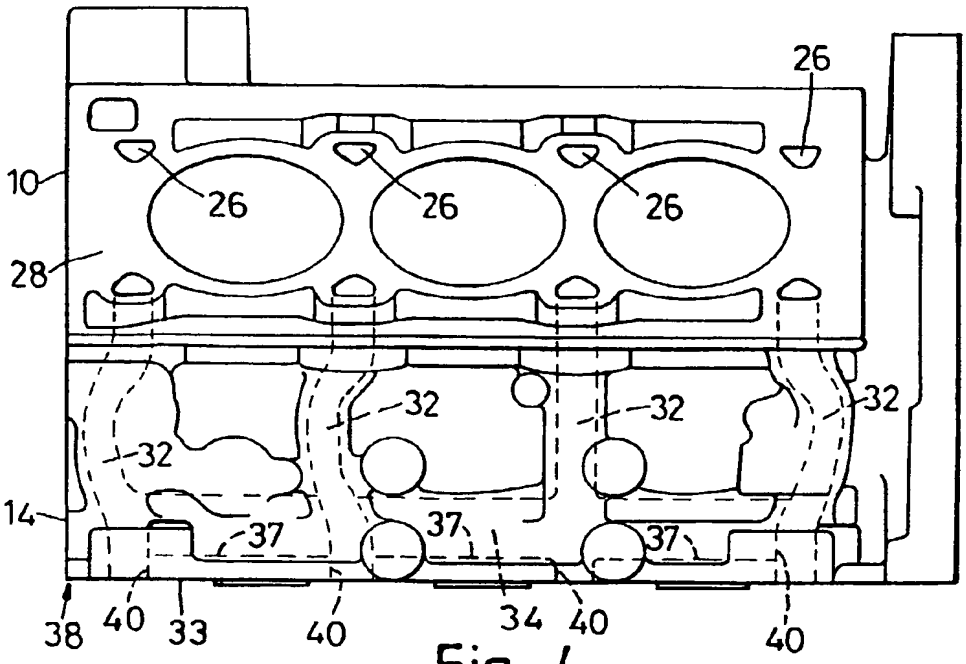

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Fig. 4

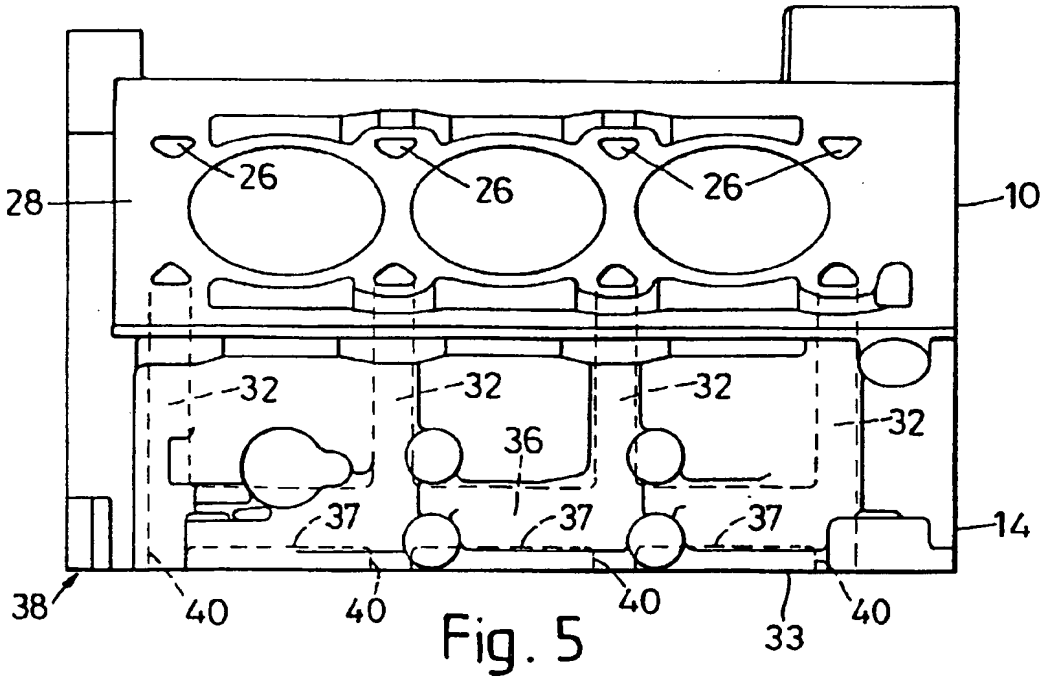
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Fig. 5